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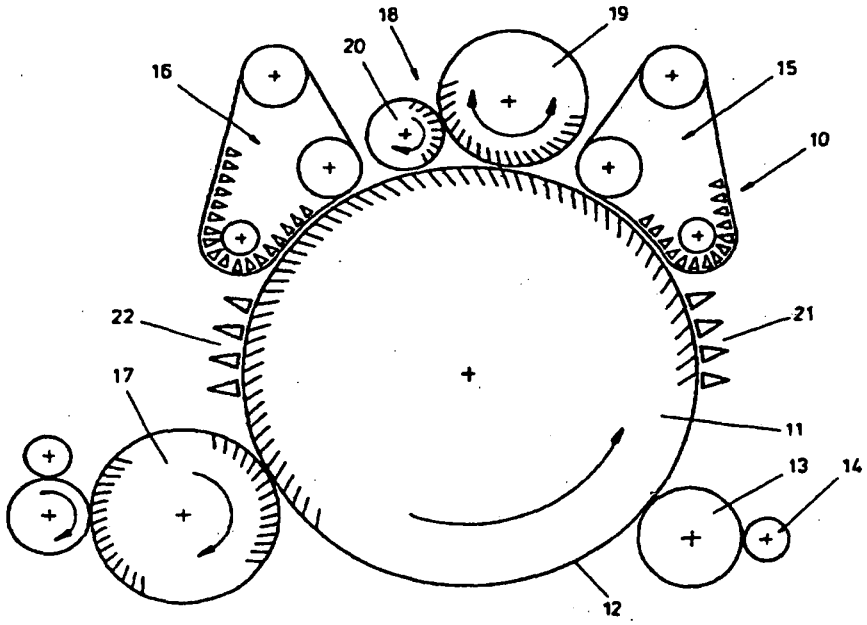
(54) Title: CARDING MACHINE

(57) Abstract

A carding machine (10) which comprises a carding cylinder (11) carrying carding wires on its cylinder periphery (12), a taker-in (13) arranged adjacent to the cylinder periphery (12) to supply fibrous material to be carried as a web by the cylinder (11) and which is to be worked-on by fibre working components arranged adjacent to the cylinder periphery, a main doffer (17) circumferentially spaced from the taker-in (13) and operative to remove the processed web from the cylinder (11), a first set of flats (15) arranged adjacent to the cylinder periphery (12) at a location intermediate the taker-in (13) and the main doffer (17) with respect to the direction of rotation of the cylinder (11) and operative to apply a preliminary cleaning and orientation to the fibres in the web carried by the carding cylinder (11), a second set of flats (16) arranged adjacent to the cylinder periphery (12) at a location downstream of the first set (15) and upstream of the doffer (17) and operative to apply a further cleaning and orientation to the fibres in the web, and an intermediate doffer/fibre return arrangement (18) adjacent to the cylinder periphery (12) and located between the first and second sets of flats (15, 16), and comprising a doffer (19) which is operative to remove a major proportion of the fibrous material from the web carried by the cylinder (11), after the web has left the first set of flats (16), and which doffer (19) is also operative to randomise the fibre orientations prior to return of the fibrous material to the cylinder (11) for subsequent treatment by the second set of flats (16).



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CARDING MACHINE

This invention relates to a carding machine which comprises a carding cylinder, and a set of flats co-operable with the outer periphery of the cylinder in order to carry out a working operation on a web of fibres carried by the cylinder.

In the carding of cotton and other fibres, it is usual to provide a main carding cylinder, a taker-in which feeds a raw material supply of fibres to be processed to the cylinder and which forms a web of fibres carried by the wire teeth of the cylinder, a series of flats arranged adjacent to the outer periphery of the cylinder to carry out working operations on the web, and a doffer to remove the processed web from the cylinder. The flats are arranged at a circumferential location intermediate the taker-in and the doffer, with respect to the normal direction of rotation of the cylinder, and may comprise stationary flats or movable flats.

The working operations carried out on the web of fibres, by co-operation between the carding cylinder, taker-in, doffer and stationary or movable flats is well known to those of ordinary skill in the art, and need not be described in detail herein. The working operations serve to clean the fibres by removing trash, dust, husks etc, and also apply orientation to the fibres generally lengthwise of the web.

Generally speaking, it is considered that the greater the number of fibre working components used in a carding machine, the better the carding action, but this has to be balanced by taking steps to minimise the removal at the same time of usable or "good" fibres which inevitably tends to occur as a consequence of the working operations to remove trash and improve the orientation of the fibres.

With this in mind, tandem cards are used, in which a first carding cylinder and its associated fibre working components carry out an initial treatment, and the treated web which issued from the first carding cylinder then passes to a second carding cylinder and related components to carry out a final treatment. This results in production of an improved web, which is subsequently formed into sliver, and while this involves inevitable higher capital cost, it is an option which

is selected by many customers for particular circumstances.

However, in view of the increased capital cost of a tandem set-up, there is a need to improve the performance of a single carding machine type of set-up so as to approach, or hopefully equal the performance of a tandem card, but at a lower capital cost.

The present invention addresses this problem, and seeks to provide a solution to the problem by a novel and inventive combination of fibre working components co-operating with a carding cylinder.

According to the invention there is provided a carding machine which comprises a carding cylinder carrying carding wires on its cylinder periphery, a taker-in arranged adjacent to the cylinder periphery to supply fibrous material to be carried as a web by the cylinder and which is to be worked-on by fibre working components arranged adjacent to the cylinder periphery, a main doffer circumferentially spaced from the taker-in and operative to remove the processed web from the cylinder, a first set of flats arranged adjacent to the cylinder periphery at a location intermediate the taker-in and the main doffer with respect to the direction of rotation of the cylinder and operative to apply a preliminary cleaning and orientation to the fibres in the web carried by the carding cylinder, a second set of flats arranged adjacent to the cylinder periphery at a location downstream of the first set and upstream of the doffer and operative to apply a further cleaning and orientation to the fibres in the web, and an intermediate doffer / fibre return arrangement adjacent to the cylinder periphery and located between the first and second sets of flats, and comprising a doffer which is run at doffing speed to remove a major proportion of the fibrous material from the web carried by the cylinder, after the web has left the first set of flats, and which doffer is also operative to randomise the fibre orientations prior to return of the fibrous material to the cylinder for subsequent treatment by the second set of flats.

It is already known from GB 1229556 to provide a carding

machine having a main carding cylinder, a feed roller and taker-in to supply fibres to the periphery of the carding cylinder, a doffer circumferentially spaced from the taker-in and operative to remove carded fibres from the main cylinder, and first and second sets of card flats located adjacent to the periphery of the main carding cylinder at positions intermediate the taker-in and the doffer. Also, a circumferential space is defined between the first and second sets of flats, in which there is located a co-operating pair of rollers, one of which is a worker roller which is run at slow (working) speed to apply a carding action as it takes fibres off the clothing of the main carding cylinder and carries them on its surface until they are stripped off by an adjacent roller which is a stripper roller, and which then returns the fibres to the clothing of the main carding cylinder where further carding takes place.

However, as its name implies, the worker roller functions to exert a working (carding) action as it removes the fibrous web from the clothing of the main cylinder, (after the web has undergone initial carding action between the first set of flats and the clothing), and then after stripping off of the removed portion of the web from the worker roller by the stripper roller, the web is then returned to the clothing when further carding takes place.

The present invention does not utilise a worker roller to remove the fibrous web from the teeth of the main carding cylinder, but instead employs a toothed roller which functions as a "doffer", and whose function is such as to deliberately "randomise" the orientation of the fibres carried by the web, which promotes a further cleaning action, and then the randomised fibres are returned to the teeth of the main cylinder in a randomised state, (as compared with the orientation of the fibres after undergoing preliminary carding action between the first set of flats and the main cylinder), and this randomised web of fibres then goes forward for further cleaning and orientation by reason of co-operation with the second set of flats. As will be well known to those of

ordinary skill, the action of a doffer is such that virtually no carding action takes place, and the use of an intermediate "doffer" in the invention is a fundamentally different type of action to a worker/stripper whose primary purpose is to "card".

The function of the intermediate doffer in a carding machine according to the invention is therefore fundamentally different from the function of the worker roller in the known carding machine, and gives rise to enhanced carding efficiencies (and especially to improved effectiveness of the second set of flats), while still achieving a satisfactory orientation of the fibres in the web which is removed by the main doffer.

Preferably, a stripper roller is cooperative with the doffer roller in order to return the fibrous material to the main cylinder.

The first and second sets of flats may be movable flats, and in addition, preferably a first set of stationary flats is arranged downstream of the taker-in and upstream of the first set of flats.

It is still further preferred to include a set of stationary flats arranged downstream of the second set of flats and upstream of the main doffer.

The relative peripheral speeds of the main cylinder and of a toothed roller functioning as the intermediate doffer are such as to enable the toothed roller to exert a "doffing" action. A typical peripheral speed ratio may be about 17:1, although it should be understood that other peripheral speed ratios may be provided, sufficient to enable the intermediate toothed roller to exert a doffing action.

A preferred embodiment of carding machine according to the invention will now be described in detail, by way of example only, with reference to the accompanying single figure of schematic drawing.

Referring now to the drawing, this is a schematic illustration of a carding machine according to the invention, and which is primarily intended to form a cleaned web of cotton or other fibres, which can be subsequently removed after

processing to form a sliver.

The carding machine is designated generally by reference 10, and comprises a main carding cylinder 11 which is rotatable in the direction of the arrow, and which carries carding wire teeth, as shown, on its outer periphery 12. A taker-in 13 receives a supply of fibrous raw material to be processed from feed roll 14, and transfers this to the periphery 12 of the cylinder 11 in usual manner. A web of fibres is applied to the cylinder periphery 12, and this web undergoes successive fibre working operations, as the cylinder rotates, so as to clean the fibres by removing trash and unwanted particles, and at the same time orientation of the fibres takes place so as to extend generally lengthwise of the web.

A main doffer 17 is circumferentially spaced from the taker-in 13, with respect to the direction of rotation, and serves to remove the processed web from the cylinder and to convey this web to sliver-forming equipment (not shown). A first set of flats designated generally by reference 15 is arranged adjacent to the outer periphery 12 of cylinder 11 and at a location intermediate the taker-in 13 and the main doffer 17, with respect to the direction of rotation of the cylinder 11. A second set of flats, designated generally by reference 16, is arranged adjacent to the outer periphery 12 at a location downstream of the first set of flats 15, and upstream of the main doffer 17.

The first and second sets of flats 15 and 16 comprise, for preference, movable or so-called revolving flats, as shown schematically in the drawing.

In order to improve the working of the fibres on the web, an intermediate doffer / fibre return arrangement 18 is arranged adjacent to the outer periphery 12 at a circumferential location between the first and second sets of flats 15 and 16. The arrangement 18 comprises a first toothed roller 19 which is run at "doffing speed" to remove a major proportion of the fibrous material from the web which is carried by the main cylinder 11. A second and smaller diameter toothed roller 20 co-operates with the roller 19, as a stripper

roller, in order to strip the removed material from the roller 19 and return it to the, or any, remaining web material on the periphery 12.

In a typical arrangement according to the invention, the main doffer 17 can be operated to produce, say, 70 grains per yard sliver, in which case the speed of the intermediate doffer 19 can be set such that (if the web from it were to be condensed into sliver), it would be 30 grains per yard sliver when it is running at its fastest, and 200 grains per yard when running at its slowest speed.

The roller 19 functions in the manner of a doffer, and has a peripheral speed which is considerably slower than the peripheral speed of the carding cylinder 11. A typical peripheral speed ratio of carding cylinder 11 to intermediate doffer cylinder 19 is 17:1, but this figure is given by way of example only. The action of a doffer on a carding cylinder is quite different from the action of a worker or stripper roller, as will be well known to those of ordinary skill in the art, and need not be described in detail herein.

The function of the intermediate doffer roller 19 is to remove a major proportion of the partly-worked web of fibres carried by the teeth of the carding cylinder 11 (the partly worked web is formed as a result of interaction between the cylinder wire teeth or card clothing of the main cylinder 11 and the first set of flats 15), and the intermediate doffer roller 19 deliberately disturbs the orientation of the fibres in the web. The intermediate doffer roller 19 therefore operates to "randomise" the fibres and disrupt the initial orientation imparted to the fibres on the web by reason of co-operation between the teeth of the first set of flats 15 and the teeth of the carding cylinder 11.

In a typical arrangement, 60% to 80% of the partly worked web can be removed by the intermediate doffer roller 19, and then the fibres undergo randomisation prior to removal from the roller 19 by stripper roller 20 and subsequent return to the cylinder 11, ready for onward movement into co-operation with the second set of flats 16.

The doffer 19 therefore disrupts the initial orientation of the fibres in the web, and this greatly assists in further cleaning of the web and removal of undesired trash and short fibres, prior to return of the further cleaned web to the cylinder 11, but now with randomised distribution i.e. non-uniform orientation of fibres.

Bearing in mind that conventional wisdom would indicate that most effective cleaning and orientation of fibres in the web can only be achieved by successive combing type interactions between the teeth of the carding cylinder and the usual successive fibre-working elements spaced apart along the periphery of the carding cylinder between the taker-in and the main doffer, it is directly counter to this perceived wisdom to take deliberate steps to disrupt the initial orientation of the fibres in the web, in the circumferential region of the cylinder between the first and second sets of flats.

The present invention is therefore based on the surprising discovery that the provision of an intermediate doffer / fibre return arrangement (e.g. as shown at 18 in the preferred embodiment of the invention) results in improved cleaning efficiency i.e. removal of trash and unwanted short fibres, but without resulting in any significant deterioration in the quality of web i.e. the orientation of the fibres of the web as it is transferred from the cylinder 11 to the main doffer 17.

In the schematically illustrated embodiment, further fibre working components are arranged adjacent to the outer periphery 12, and comprise a first set of stationary flats 21, arranged downstream of the doffer 13 and upstream of the first set of flats 15, and a second set of flats 22, comprising stationary flats, which are arranged upstream of the doffer 17 and downstream of the second set of flats 16.

The required fibre working operations are carried out by co-operation between the wire teeth on the outer periphery 12 of the carding cylinder 11, and the fibre working elements of the working components arranged adjacent to the periphery 12. The flats 21 and 22 are stationary, but the fibre working

elements of the flats 15 and 16, and of the toothed rollers 19 and 20 are continuously movable, and this of course is relative to the circumferential movement of the wire teeth on the cylinder periphery 12. It is presently preferred that the travelling flats of the sets 15 and 16 move in the same direction as, but at a different linear speed to the teeth on the cylinder periphery 12, and the second toothed roller 20 rotates in the direction of the arrow shown, so as also to have its periphery, (where it is adjacent to the cylinder periphery 12), moving in the same general direction, but again at a different speed. However, with regard to the first (and larger diameter) toothed roller 19, it has been found to be advantageous to rotate in either direction, as shown, provided that it functions as a doffer in co-operation with the main carding cylinder 11.

In summary, the known disclosure of worker/stripper rollers in GB 1229556 will mean, to the man of ordinary skill in the art, the provision of a carding function between the first and second sets of flats. By contrast, in the invention, an intermediate doffer is provided, and which does virtually no carding, but is run at sufficient relative doffing speed to remove the fibres from the main carding cylinder, after such fibres have been made to stream between the circumferential grooves of the cylinder by the first set of flats. The intermediate doffer then lifts these fibres out of the cylinder wires, and deposits them back onto the tops of the cylinder wires, so that the second set of flats can then re-card them, and in a more effective manner than would be possible in the absence of the intermediate doffer arrangement.

The known worker/stripper system will carry out some small amount of removal of fibres from the main cylinder, while carrying out a carding action, and then replacing the fibres on the carding cylinder, but in such a way that, in practice, there will be virtually no improvement in carding effectiveness, in that the second set of flats in the known arrangement are ineffective to supply any significant further carding action.

The intermediate doffer employed in the invention is run at a suitable doffing speed where no significant amount of carding takes place, so that the majority of fibres presented to it are captured and then transferred back to the carding cylinder, and in a way which allows much more effective subsequent carding action by the second set of flats.

It is preferred that the intermediate doffing arrangement provided in a carding machine and carding method according to the invention operates in such a way as to remove at least 60 to 70% of the fibres being carried by the main carding cylinder (after leaving the first set of flats), and then returns these fibres in randomised or non-parallel orientation, to be carried by the tips of the carding wires, and which then gives the second set of flats enough fibrous material that the second set of flats can carry out an effective additional carding operation, and which will be much more effective than would be the case in the absence of the intermediate doffer arrangement.

CLAIMS

1. A carding machine (10) which comprises a carding cylinder (11) carrying carding wires on its cylinder periphery (12), a taker-in (13) arranged adjacent to the cylinder periphery (12) to supply fibrous material to be carried as a web by the cylinder (11) and which is to be worked-on by fibre working components arranged adjacent to the cylinder periphery, a main doffer (17) circumferentially spaced from the taker-in (13) and operative to remove the processed web from the cylinder (11), a first set of flats (15) arranged adjacent to the cylinder periphery (12) at a location intermediate the taker-in (13) and the main doffer (17) with respect to the direction of rotation of the cylinder (11) and operative to apply a preliminary cleaning and orientation to the fibres in the web carried by the carding cylinder (11), a second set of flats (16) arranged adjacent to the cylinder periphery (12) at a location downstream of the first set (15) and upstream of the doffer (17) and operative to apply a further cleaning and orientation to the fibres in the web, and an intermediate doffer / fibre return arrangement (18) adjacent to the cylinder periphery (12) and located between the first and second sets of flats (15, 16), and comprising a doffer (19) which is run at doffing speed to remove a major proportion of the fibrous material from the web carried by the cylinder (11), after the web has left the first set of flats (16), and which doffer (19) is also operative to randomise the fibre orientations prior to return of the fibrous material to the cylinder (11) for subsequent treatment by the second set of flats (16).

2. A carding machine according to claim 1, in which a stripper roller (20) is cooperative with the doffer roller (19) in order to return the fibrous material to the main cylinder (11).

3. A carding machine according to claim 1 or 2, in which the first and second sets of flats (15 and 16) are movable flats.

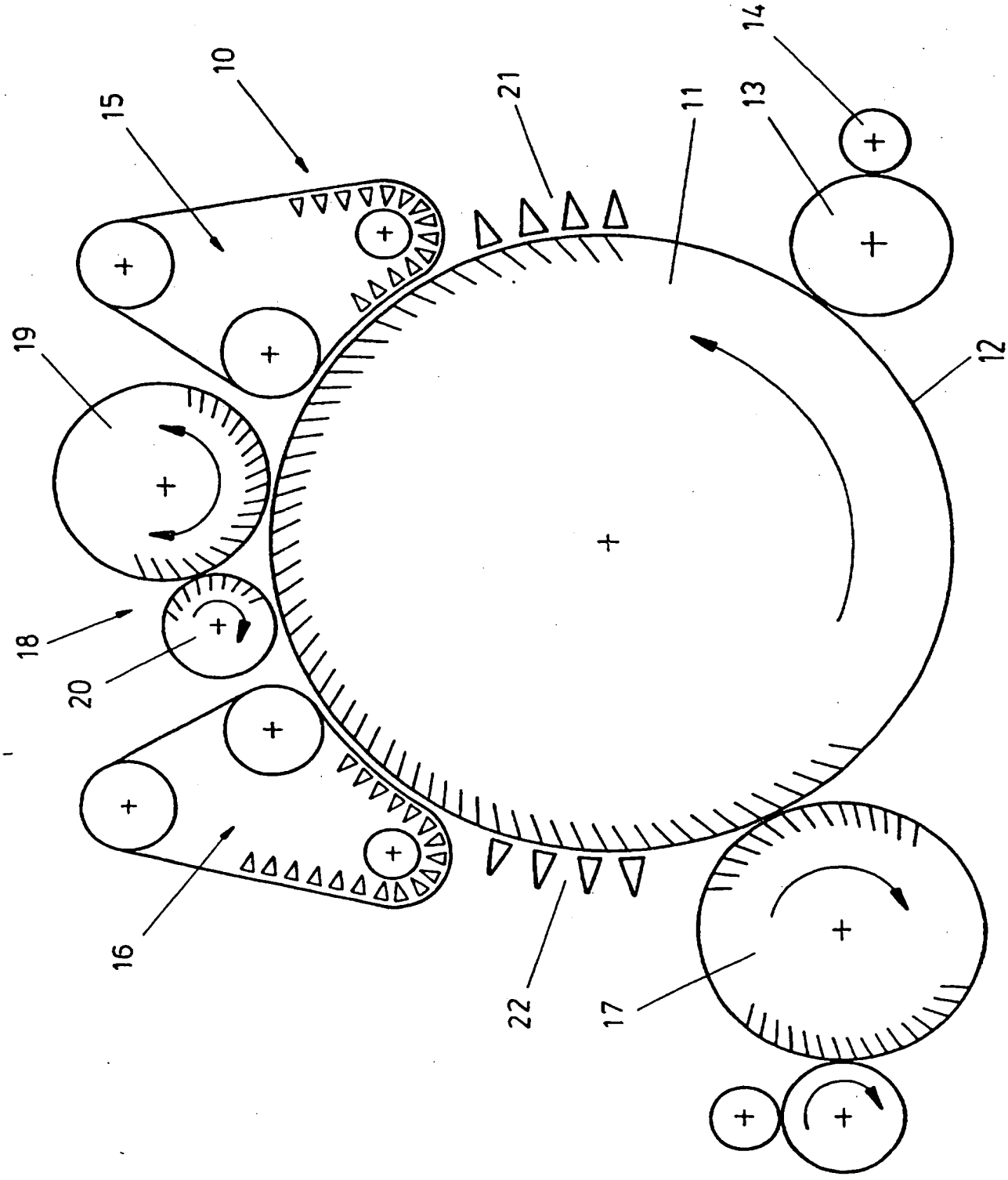
4. A carding machine according to any one of the

preceding claims, including a first set of stationary flats (21) arranged downstream of the taker-in (13) and upstream of the first set of flats (15).

5. A carding machine according to any one of the preceding claims, including a set of stationary flats (22) arranged downstream of the second set of flats (16) and upstream of the doffer (17).

6. A carding machine according to claim 2, in which the doffer (19) is a toothed roller of substantially greater diameter than the stripper roller (20).

7. A carding machine according to claim 6, in which the peripheral speed ratio of the carding cylinder (11) to the doffer (19) is about 17:1.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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/GB 97/02676

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D01G15/08

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D01G

Documentation searched other than minimumdocumentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category '	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 43 02 075 A (WIRKBAU TEXTILMASCHINEN GMBH) 28 July 1994 see column 4, line 58 - column 5, line 29; claims 1-4; figures 1,5,8-10	1-4
A	---	6
Y	DE 18 10 968 A (PROSS,H.GEB.SCHÖTTLER) 30 July 1970 see the whole document	1-4

A	DE 28 619 C (GAWTHORP,W.ET AL) 3 September 1884 see the whole document	1

A	GB 204 744 A (ISHERWOOD,E.H.) 1 November 1923 see the whole document	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/GB 97/02676

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2 908 046 A (HIROSHI OHNISHI) 13 October 1959 see column 2, line 52 - column 3, line 11; claim 1; figure 1	1

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INTERNATIONAL SEARCH REPORT

information on patent family members

Inter nal Application No
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		JP 7054220 A	28-02-95
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GB 204744 A		NONE	
US 2908046 A	13-10-59	NONE	